

## Inheritance of Colour in *Diaphora mendica*, Cl., and var. *rustica*, Hb.

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In 1913 I started breeding experiments with *Diaphora mendica* type and var. *rustica*, with a view to proving the presence or absence of segregation of colour in the males in subsequent generations.

Unfortunately the war prevented me from carrying them out fully, but I think the results obtained were sufficiently interesting to be worth publishing. The well-known cream coloured form of the male, var. *rustica*, appears to be the only one found in Ireland. In Great Britain the dark brown type form is almost universal, but pale coloured males have been recorded from the east coast of Scotland and I have seen one from Kent.

My original stock of var. *rustica* was obtained from Captain R. S. Gwatkin-Williams, R.N., who sent me three dozen larvæ bred from eggs laid by a female taken near Queenstown in 1911. These did well and I obtained a number of pupæ from a pairing *inter se*.

In the autumn of 1912 I received a number of pupæ from Durham, Suffolk and Somerset. The males of the first two broods were poorly spotted and not very dark, but the Somerset males were very dark brown and both sexes were heavily spotted.

The pupæ were forced and imagines began to emerge on February 21st, 1913. At first I had great difficulty in obtaining a cross pairing, but later on I experienced no difficulty and obtained seven cross pairings, four var. *rustica* ♂ × type ♀ (2 Durham, 2 Taunton) and three type ♂ × var. *rustica* ♀. I also obtained five pairings of var. *rustica*. All the ova proved fertile, and the larvæ thrived until they were nearly full grown. Disease then appeared and the majority died. At the end of the season I had 35 pupæ of Brood I. and 117 of Brood II., both var. *rustica* ♂ × type ♀ (Durham), 20 pupæ of Brood III. type ♂ (Durham) × var. *rustica* ♀, and only 17 pure bred var. *rustica*, two broods giving only one pupa apiece.

This shortage of pure var. *rustica* prevented me from obtaining pairings with the cross-bred insects in 1914. The pure bred *rustica*, in spite of the close inbreeding for three generations remained very pale cream coloured in the male sex, and showed no increase in brown colour such as has been stated to occur. A single specimen showed very pretty clouding of the outer and lower part of the forewing and of the posterior half of the hindwing with greyish-brown scales.

In 1915 emergence of the cross-bred var. *standfussi* (F.1) began on March 5th, and I obtained pairings without difficulty. I had eggs from six pairings, two ♂ var. *standfussi* (Brood II.) × ♀ var. *standfussi* (Brood II.), one ♂ var. *standfussi* (Brood III.) × ♀ var. *standfussi* (Brood III.), one ♂ var. *standfussi* (Brood II.) × ♀ var. *standfussi* (Brood I.), and one pure var. *rustica*. All the ova were fertile. To avoid risk of loss I sent a number away to friends, but all contracted disease and died. Those I kept myself did well until June, when many were nearly full grown, but eventually I obtained only ten pupæ (F.2) of Brood IV., ♂ var. *standfussi* (Brood II.) × ♀ var. *standfussi* (Brood II.).

The appearance of the males of the first generation of var. *standfussi* is stated to be intermediate in colour between the males

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of the type and var. *rustica*. Of Brood II. (1915) F.1, I had more than 40 males. These varied from a cream colour a little deeper than any of my pure bred var. *rustica*, though paler than some *rustica* I have seen, to a creamy brown a good deal paler than that of any typical male. Of Brood III. (1915) F.1 I had six males, of which three were no darker than my var. *rustica*, and three pale creamy brown specimens.

In 1916 from Brood IV., F.2, I bred only seven imagines, five males and two females. Two of the males were quite as pale as my var. *rustica*, in fact paler than many of them. One was beautifully clouded with greyish brown scales on the fore- and hindwings, similar to the var. *rustica* bred in 1914, and one was as dark as the darkest of my var. *standfussi*, F.1, generation. Two pairings were obtained with two pale males and the two females (Broods I. and II., 1917, F.3), and their offspring had the following constitution:—

$$\begin{array}{l} \text{♂ (Brood IV.)} \quad \frac{\text{♂ Brood II. (♂ var. } i{rustica} \times \text{♀ type)}}{\text{♀ Brood II. (♂ var. } i{rustica} \times \text{♀ type)}} \times \\ \text{♀ (Brood IV.)} \quad \frac{\text{♂ Brood II. (♂ var. } i{rustica} \times \text{♀ type)}}{\text{♀ Brood II. (♂ var. } i{rustica} \times \text{♀ type)}} \end{array}$$

The ova were all fertile and the larvæ did well until late in their last instar, when many became diseased and died.

In the case of Brood I. (F.3) the ground colour of twenty of the males was very pale, in some actually paler than in many of my pure bred var. *rustica*. One was shaded with brown scales over the central and posterior portion of the forewing and the whole of the hindwing, especially in the interneural spaces, and the thorax was pale greyish brown. It resembled the var. *rustica* bred in 1914, and the male of Brood IV., 1916, but was darker and more handsome than either. The brood was fairly well spotted in the case of both sexes.

In the case of Brood II. also the ground colour was pale. Six males were no darker than my var. *rustica* and the rest were of various shades of pale creamy brown. The darkest was about the same colour as the middle specimen of Brood II. var. *standfussi*, F.1, arranged in order of depth of colour. All were very lightly spotted, and in this respect contrasted strongly with Brood I., in spite of their closely related ancestry.

Two males and one female had no marginal spots on the hindwings, as in several F.1 specimens of Brood II. The results show that no segregation of the dark brown colour of the type form takes place either in F.2 or F.3 generations.

Many of the specimens of F.2 and F.3 are as light as var. *rustica*, but in F.1 generation some were almost as pale as the pure race, whereas none were nearly as dark as the type form. Even with the small numbers bred I think it is safe to say that the pale colour of var. *rustica* and the dark brown of the type do not behave as Mendelian unit characters. With regard to breeding var. *standfussi*, F.1, it can be definitely stated that pairing was equally easy between either sex of var. *rustica* and the type.

Both crosses were equally fertile. In fact, fertility of the inbred stock was complete until the experiment was given up owing to the war, and the larvæ appeared to be as vigorous as pure bred larvæ. Imagines emerged for the most part in the afternoon and evening, but

sometimes in the morning and sometimes during the night. There is no very definite hour of emergence as in many species. Pairing also occurred at any time, sometimes in full daylight at midday, at other times near midnight.

Ova were laid the same day or oviposition was delayed till the third day. Notes on the development of ova and larvæ are worthless owing to the artificial conditions under which they were kept.

Disease was apparently introduced with the food. The early broods always did better than the late ones, though the tins and sleeves were sterilised with the same care and well matured nettle was always chosen.

There was no evidence that the disease, characterised by weakness, loss of appetite, and slight diarrhæa, was transmitted from one generation to the next, or that the rooms in which the larvæ were kept remained infected from one year to the next.

The only previous experiments on crossing the two races, on which I have read accounts, are those of Caradja and Standfuss. Caradja first crossed ♂ *rustica* × ♀ *mendica*, but all the larvæ except two died of pebrine. Next year he did much better, and found this cross perfectly fertile, though the mortality from disease was very heavy.

He found the reciprocal cross much weaker and only obtained 15% of larvæ from it. This was confirmed in later experiments. His *rustica* were from the Caucasus, and this may account for this difference in his results and mine. I found no difference in fertility in the two crosses. Caradja and Standfuss found that the F.1 generation of ♂ *rustica* × ♀ *mendica* were intermediate, but nearer to *rustica* than to *mendica*.

The reciprocal cross they found produced darker specimens, whereas the six males which I obtained were even nearer *rustica* than those bred from *rustica* ♂ × *mendica* ♀.

Probably with larger numbers the result of both crosses would be found to be similar. Caradja has named four of the forms he obtained. The very pale forms almost like *rustica* he calls var. *clara*, of which he obtained 23%, the pale intermediate he calls var. *standfussi*, of which he obtained 24%, and the dark intermediate forms var. *mus*, of which he obtained 33%.

In my series these three forms merge into one another so evenly that I can see no advantage in giving them separate names, and Standfuss calls them all *standfussi*. Caradja himself had about 20%, which he could not definitely place under his varietal names.

His fourth form, of which he bred three males, he calls ab. *mixta*. It had a ground colour like var. *clara*, with a central cloud over the forewings. This appears to be almost identical with the form of which I bred two specimens, one in 1916 and one in 1917. It is a very distinct and beautiful aberration. Caradja crossed his var. *standfussi* with both ♂ and ♀ *rustica* and *mendica*, but does not describe their progeny. He also inbred his *standfussi*, but only obtained a few weak larvæ, so that his experiments throw no light on the question of whether segregation occurred in the F.2 generation or not.

The results obtained by Caradja and Standfuss show that the colouring of var. *rustica* appears more strongly in the F.1 generation in the males than that of *mendica*. This result is confirmed by me, and I found further that it extended to the F.2 and F.3 generations. The

inference drawn by Standfuss from this is that *rustica* is a more ancestral form than *mendica*. *Rustica* is found in the eastern and western outskirts of the range of the insect, and in the east appears to occupy a higher altitude than typical *mendica*.

It is found in Ireland, Hungary, Roumania, the Caucasus, Cilicia, and Armenia. This may be explained by the newer form with a dark brown male having arisen somewhere in the centre and spread in all directions towards the periphery.

Caradja.—*Societas Entomologica*. Zürich.

1894-1895. ix., No. 7, p. 49.

1895-1896. x., No. 7, p. 49.

Standfuss.—*Handbuch. Paläarkt. Gr. Schmetter.*

f. Forscher u. Sammler, 1896. p. 223.

(9 Figures.)

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### The various modes of Emergence and the Number of Annual Broods of the Grypocera and of the Rhopalocera of Southern Europe, illustrated by the Tuscan species.

By DR. ROGER VERITY.

(Continued from p. 72.)

*Polyommatus icarus* and *Agriades thersites* behave in much the same way as *C. pamphilus*, having also two graduated broods, and sometimes, between these, two apparent broods. The first brood emerges in Florence from the 10th of April, is very abundant at the end of May and in the first half of June ("nucleus" of that brood) and then diminishes till the end of July; it is distinguished by the decided grey colour of the underside of the wings, and by the greenish metallic scales of the base of the hind wings; the females are besides adorned by blue scales more or less abundant on the upper side. This characteristic however diminishes in June, when numerous individuals appear that do not show it, therefore it would seem attributable to secondary characteristics acquired by the individual from external conditions during the development of the wings in the chrysalis; in fact there appear also in the second brood some rare individuals who present it. The second brood emerges from the first days of July to the middle of September; it is distinguished in a special manner by the usual tawny colour of the underside, which is seen in summer in so many species, especially on the hindwings, and by the absence of the greenish metallic scales at the base. In Florence, according to Querci, this brood remains more or less constant in numbers during August and till the 15th of September. At Forte dei Marmi it becomes much more abundant at the end of August and at the beginning of September ("nucleus" of the second brood), but I am ignorant of what happens later. In Elba the first brood ceases to emerge at the end of May, and the second at the end of August; the species is scarce in that locality, compared with Florence, and the broods are shorter. With regard to this it is instructive to note the erroneous interpretations of data which one may commit for want of general knowledge of the different types of emergence. In vol. xlviii of *Bull. Soc. Ent. Ital.*, p. 193, I gave the following indications on the *icarus* of Elba (Poggio): "first brood, ♂ till 29th